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GYMNOTHORAX ROBINSI (ANGUILLIFORMES, MURAENIDAE), A NEW DWARF MORAY WITH SEXUALLY DIMORPHIC DENTITION FROM THE INDO-PACIFIC

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ABSTRACT

A new dwarf species of moray taken in the western Pacific and Indian Oceans, *Gymnothorax robinsi,* is described. It is distinguished from other species of *Gymnothorax* by its small size (largest specimen 182 mm), its color pattern (usually brown with small irregular white spots, the fins with oblique dark and white bars), and its low vertebral count (total vertebrae 105–112). It exhibits sexual dimorphism in dentition, the jaw teeth of females biserial and numerous, those of males uniserial and fewer.

Vertebral counts have long been one of the diagnostic characters sometimes used in the description of fish species; the vertebral formula, as defined in Böhlke, 1982, has been especially useful in studies of eels. During long-term studies of the family Muraenidae, representatives of known species were x-rayed to establish the vertebral formula for each, and questionable individuals in new collections were x-rayed to aid in identification. Several small muraenids collected in the Seychelles in 1964 and identified as *Gymnothorax* sp. were found to have an unusual vertebral count, much lower than that associated with any known species of that genus. They were put aside as *Gymnothorax '108'* for future study when additional and larger specimens might become available. A few more small individuals from the western Pacific were found during the following years. In 1989, 21 specimens from Fiji were sent to the author by Richard Winterbottom for identification, and in 1991 three specimens from the Maldives were sent by John E. Randall; they all were small, had low vertebral counts and similar (although variable) coloration, and possessed extremely variable dentition. Additional study revealed the specimens to be a new species of dwarf moray with sexually dimorphic dentition; they are described below as *Gymnothorax robinsi.*

METHODS

Methods and terminology are as defined in Böhlke et al. (1989). Proportions are expressed in terms of total length (TL), measured from the snout tip to the tip of the tail, or head length (HL), from snout tip to the posterodorsal margin of the gill opening. Preanal length is measured from snout tip to mid-anus; body depth is measured at the gill opening and at the anus and does not include the fins; snout length is measured from snout tip to the anterior margin of the eye; upper jaw length is from snout tip to the external inner angle of the mouth, lower jaw length from tip of lower jaw to the external inner angle of the mouth. Vertebral counts are obtained from radiographs as explained in Böhlke (1982); the mean vertebral formula (MVF) is expressed as the mean values for predorsal-preanal-total counts. Tooth counts are approximate and include sockets of missing teeth.

Gymnothorax robinsi new species
Figures 1–3

Holotype.—ANSP 144431 (1, 144 mm TL, male); Indonesia, Kai Island, off NW corner of Tajandoe Island, 05°31′24″S, 132°17′48″E, 3–6 m; B.B.Collette, BBC-1745; 7 July 1979.

Paratypes.—A total of 32 specimens, 65–182 mm TL.

FIJI: ROM 42849 (1, 123); Great Astrolabe Reef, Dravuni Island ca. 300 m off USP field station on Bommie, 18°45′27″N, 178°31′13″E; R.Winterbottom et al.; 28 Mar 1983. ROM 42850 (2, 62–107);

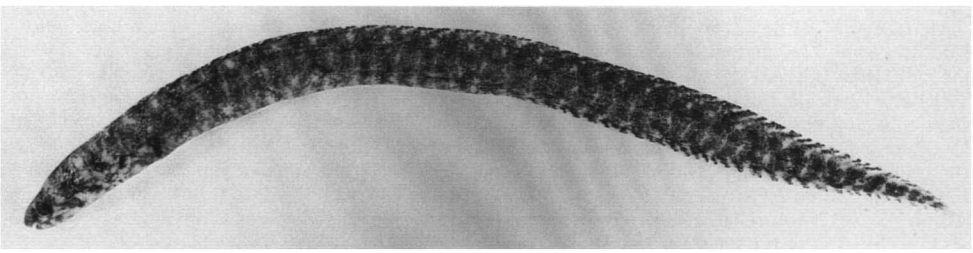

Figure 1. ANSP 144431, 144 mm, holotype of *Gymnothorax robinsi* (photograph by Dominique A. Didier).

Great Astrolabe Reef, south coast of Vanuakula off sandy beach, 18°44′18″N, 178°30′45″E; R.Winterbottom et al.; 3 April 1983. ANSP 173507 (1, 150), CAS 82351 (2, 131–140), ROM 42851 (7, 65–111), and USNM 337541 (2, 119–137); Viti Levu, Suva harbour at Rattail Pass, west side, 18°08′29″N, 178°23′13″E; A.R.Emery et al.; 13 April 1983. ROM 42852 (5, 77–131); Viti Levu, reef top off SW corner of Makuluva Island, 11 km ESE of Suva, 18°11′14″N, 178°31′19″E; R.Winterbottom et al.; 19 April 1983. ROM 42853 (1, 182); Viti Levu, Rattail Passage off Lamai, W side 100 m from entrance, 18°08′22″N, 178°23′08″E; R.Winterbottom et al.; 19 April 1983.

NEW GUINEA: ANSP 144432 (1, 156); Papua, Bagabaag Island, 04°46′30″S, 146°09′30″E, to 4.6 m; B.B.Collette, BBC-1702; 19 June 1979.

PHILIPPINES: ANSP 144433 (1, 109): Sulu Sea, Palawan, mouth of Puerto Princesa Bay, South Point Reef; R.E. Schroeder, G. Hendler; 7 Aug.1979. ANSP 164936 (1, 152); Solino (Selinog) Island, SW side Zamboanga Del Norte, Mindanao, 08°51′06″N, 123°24′42″E, 13.7–21.3 m; L.Knapp et al, LK79-6; 2 May 1979.

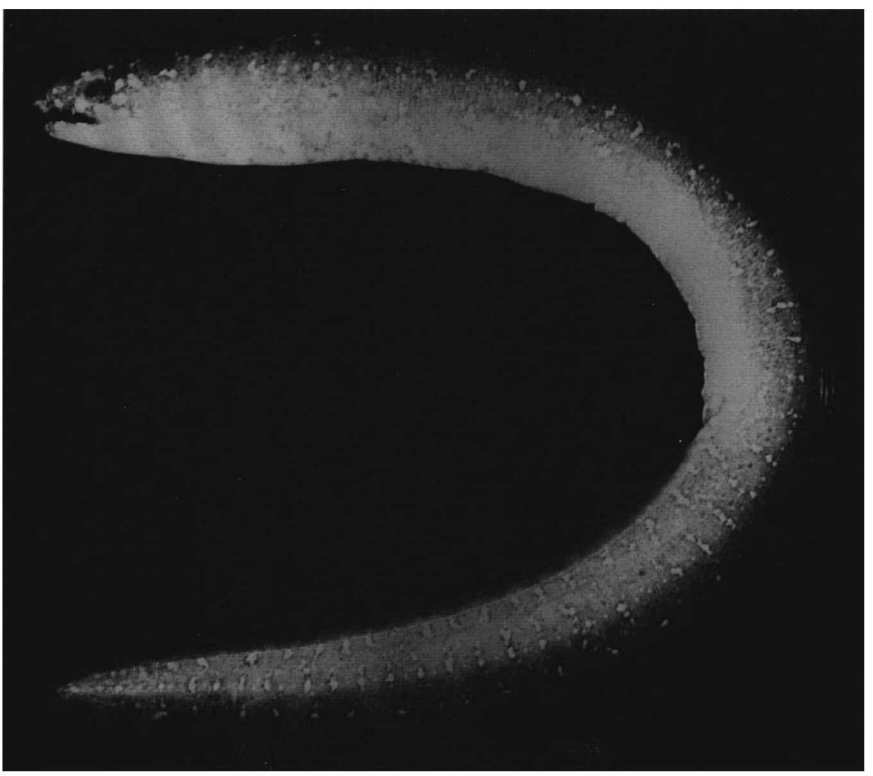

Figure 2. BPBM 32868, 102 mm, paratype of *Gymnothorax robinsi* (photograph by John E. Randall).

MALDIVES: BPBM 32868 (3, 92–105); Ari Atoll, reef N of Bathala Island, E side, rubble bottom, 35m, rotenone; J.E.Randall, M.S.Adams; 6 March 1988.

SEYCHELLES: ANSP 138726 (1, 125): Amirante Islands, Eagle Island, off N end, 05°07′S, 53°19′E, 6–9 m; J.E.Böhlke et al, F-85; 4 March 1964. ANSP 138727 (2, 132–153): Amirante Islands, vicinity St. Joseph Island, SW of Ressource Island off small boat entrance to lagoon, 05°26′S, 53°22′E, 15–27 m; D.Dockins, R.Rosenblatt, sta.F-110; 10 Mar.1964. ANSP 138728 (1, 118): Amirante Islands, vicinity St.Joseph Island, SW of Ressource Island, near drop-off outside boat passage, 05°26′S, 53°22′E, 24–30 m; J.E.Böhlke et al, sta.F-95; 7 March 1964. ANSP 138729 (1, 96); Farquhar Group, lagoon W of North Island, isolated low coral heads over mixed sand and weed, 10°07′22″S, 51°11′37″E; ANTON BRUUN Cr.9, HA-18; 6 Dec.1964.

Diagnosis.—A dwarf moray with variable coloration of brown and white lichen-like spots on head and body, and with distinctive dark and white oblique bars on fins; anus just behind midbody, preanal length 1.9 in TL; head large, 6.6 in TL; body moderately stout, depth at gill opening 15 in TL. Dentition sexually dimorphic; females with biserial and numerous jaw teeth and three long median intermaxillary teeth; males with uniserial and few jaw teeth, and few or no median intermaxillary teeth. Mean Vertebral Formula 7-49-107.

Description.—Table 1 presents measurements as percentages of the total length or the head length, sex, vertebral counts, and tooth counts for the holotype and 19 paratypes. Proportions of the total length or head length are given above in the Diagnosis as the mean; in the Description below, proportions for the holotype are listed first, followed by the range for paratypes in parentheses.

A small, moderately stocky moray, depth 17 (13–18) in TL; anus at or just

Table 1. Proportions as percent of total length or head length (*), sex, and counts of vertebrae and teeth of holotype** and 19 paratypes of *Gymnothorax robinsi*

Catalog number	ROM 42851	BPBM 32868	ANSP 144433	ROM 42851	ANSP 138728	USNM 337541	ROM 42849	ANSP 138726
Total length (mm)	102	102	109	115	118	119	124	125
Preanal length	51.9	52.0	52.3	52.2	52.5	52.9	50.0	50.4
Head length	14.7	16.2	15.1	14.3	14.8	15.0	14.5	14.8
Snout to dorsal fin	11.1	13.9	13.6	13.3	14.0	13.6	12.9	13.7
Depth at gill opening	7.2	6.8	6.8	5.6	6.0	6.9	6.4	6.8
Depth at anus	7.0	5.5	4.5	4.3	4.7	6.4	5.3	5.0
Length upper jaw*	38.0	36.4	37.0	37.8	37.7	37.6	36.1	34.0
Length lower jaw*	36.7	32.7	33.9	33.5	34.8	35.4	33.9	33.0
Snout length*	18.0	18.2	17.0	20.1	18.3	19.1	15.0	17.3
Eye diameter*	14.0	13.9	12.7	14.6	13.7	12.9	13.9	11.4
Width interorbital*	13.3	12.1	10.9	9.8	12.0	10.7	11.7	13.0
Vertebrae								
Predorsal	8	7	7	6	7	8	7	8
Preanal	50	49	48	50	52	50	47	50
Total	109	107	105	106	108	109	106	108
Sex	♀	♀	♂	♀	♀	♀	♂	♀
Maximum egg diameter	1.8	1.0		1.0	0.8	1.9		0.9
Teeth†								
Intermaxillary outer	8+–8+	9+–10+	6–6	8–8	6+–7+	8–8	6–6	6–7+
Median	3	2	1	3	3	3	2	3
Maxillary								
Inner	5–7	2–5	0	3–5	3–4	3–4	0	2–2
Outer	16–17	15–19	8–8	14–16	16–17	16–16	8–11	15–16
Vomerine	9	8	8	10	11	5	11	8
Dentary								
Inner anterior	4–4	4–4	3–3	4–4	4–4	4–4	4–4	3–4
Outer	22–26	27–30	10–13	26–26	23–24	28–28	17–18	25–26

† Counts given for main series of teeth; + indicates presence of additional tiny outer teeth.

behind midbody, tail usually slightly shorter than preanal length, PA 1.8 (1.8–2.0) in TL. Dorsal-fin origin far back on head, above and just before gill opening and above posterior branchial pore, the fin low anteriorly, high and conspicuous posteriorly; anal fin beginning just behind anus. Head, snout and jaws moderately long, head 6.7 (6.1–7.2) in TL; snout moderate, 5.2 (4.7–6.7) in HL; jaws subequal, upper jaw overhanging lower, upper jaw 2.6 (2.4–2.9) in HL; eye large, 7.4 (6.9–8.8) in HL, closer to rictus than to snout tip. Anterior nostril tubular, long and narrow, reaching beyond jaw tip; posterior nostril an oval pore with raised fringed rim behind anterior margin and above anterior third of eye. Head pores typical for species of *Gymnothorax* (Fig. 3): two branchial pores above and before gill opening (three on one side of one paratype), the posterior pore below dorsal-fin origin; three supraorbital pores, the anterior ethmoid pore on tip of snout, the second adjacent to anterior nostril, the third between anterior and posterior nostrils, closer to the anterior; four infraorbital pores along upper jaw, the first just behind anterior nostril, the last slightly before posterior margin of eye; six mandibular pores along lower jaw, the first on tip of lower jaw, the posteriormost below rictus. Gill opening an oval slit at or above midside, small and difficult to see.

Dentition highly variable, dependent on age and sex (see Table 1, Fig. 4). Typically, females have on each side a peripheral row of 6–8 short stout intermaxillary teeth, slightly larger posteriorly, plus 2–4 outer tiny teeth between those of the main series (indicated as + in Table 1); on the midline three long depress-

Table 1. Extended

ROM 42852	ROM 42852	CAS 82351	ANSP 137827	USNM 337451	CAS 82351	ANSP** 144331	ANSP 173507	ANSP 164936	ANSP 138727	ANSP 144432	ROM 42852	Range	Mean
127	131	131	132	137	140	144	150	152	153	156	182		
53.5	53.4	53.4	50.0	51.8	51.4	54.2	51.3	53.3	52.3	54.5	52.2	50.0–54.5	52.3
15.9	16.4	15.4	13.8	15.7	15.7	14.9	14.8	14.9	15.0	15.5	14.4	13.8–16.4	15.1
13.8	14.6	14.0	12.8	14.0	14.2	13.3	13.5	13.8	13.6	14.8	14.9	11.1–14.9	13.7
7.1	7.8	6.5	5.8	6.1	6.1	5.8	6.5	6.4	5.9	7.1	6.7	5.6–7.8	6.5
6.1	4.7	5.7	5.8	4.7	6.1	5.4	5.9	5.1	5.2	6.0	6.8	4.3–7.0	5.5
37.6	36.7	36.6	40.6	36.7	38.6	38.6	37.8	37.6	37.4	38.8	41.4	34.0–41.4	37.6
34.2	34.9	34.6	35.7	34.4	35.0	36.7	36.0	35.0	34.3	35.1	36.1	32.7–36.7	34.8
19.8	17.7	19.3	21.4	17.2	17.3	19.1	18.0	19.0	20.4	18.6	20.5	15.0–21.4	18.6
12.9	14.9	13.4	14.8	12.6	13.6	13.5	13.5	13.7	13.0	14.0	13.3	11.4–14.9	13.5
10.9	9.8	12.4	12.1	10.7	12.3	11.6	13.1	11.1	10.4	9.9	12.9	9.8–13.3	11.5
—	7	6	8	7	6	7	7	6	6	7	7	5–8	7
49	48	49	50	49	48	49	48	50	49	51	47	46–52	49
107	102	106	112	107	107	106	107	106	108	108	106	105–112	107
♂	♂	♀ 1.2	♂	♂	♂	♂	♂	♂	♂	♀ 1.6	♂		
5–5	5–5	8–8	6–6+	6–7	5–6	5–6	4–4	5–5	6–6	6–7+	5–5		
0	0	3	2	1	0	1	0	1	1	3	0		
0–0	0–0	3–3	0–0	0–0	0–0	0–0	0–0	0–0	0–0	3–3	0–0		
5–7	6–7	13–14	10–10	9–9	7–8	8–9	4–7	8–10	8–10	15–15	7–9		
3	5	13	8	13	14	9	7	9	8	11	15		
0–0	0–0	3–3	0–0	+–+	0–0	0–0	0–0	0–0	+–+	4–4	0–0		
9–9	11–11	23–24	13–17	13–17	13–13	15–15	12–12	15–16	15–20	24–26	12–13		

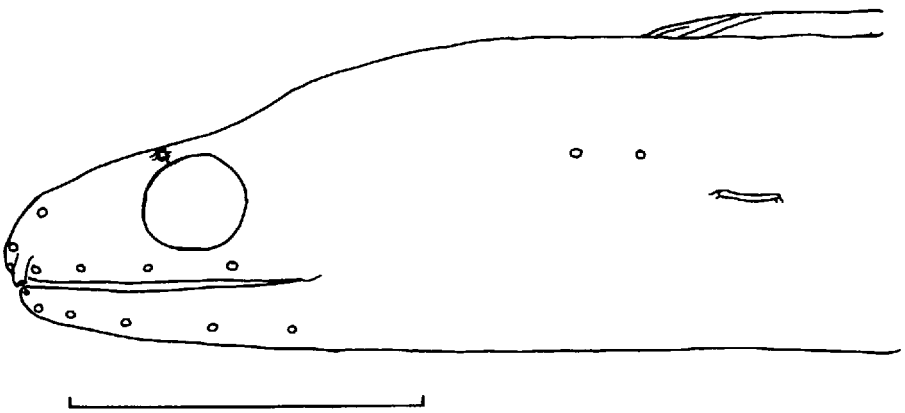

Figure 3. ANSP 144431, 144 mm, holotype of *Gymnothorax robinsi*; diagram of head and head pores. Line = 10 mm.

ible fangs, the posteriormost the longest tooth in the mouth; on maxilla an outer row of 14–19 small triangular teeth, and a shorter inner row of 2–6 tall slender depressible teeth; 5–13 short conical teeth on vomer, in an irregular staggered row in larger specimens; on dentary a main row of 20–30 small triangular teeth plus an anterior inner row of four large stout teeth. Males have fewer teeth than females on all bones; 4–6 outer intermaxillary teeth enclose 1–2 median fangs in juveniles only, the median teeth totally lacking in specimens larger than 127 mm; a single row of 4–11 teeth on maxilla; 3–15 teeth in a staggered or biserial row on vomer; and a single row of 9–20 dentary teeth, the anterior four the largest. In both sexes, teeth are fewer in larger specimens.

COLORATION IN ALCOHOL. Head, body and fins with highly variable pattern, but always with distinctive alternating dark and white bars or spots on fins posteriorly. Generally the body is medium reddish brown overall with white lichenous spots of varying sizes, plus contrasting darker brown spots which may be well defined or diffuse. Brown spots coalesce posteriorly to form irregular vertical bars which continue obliquely onto fins, where a longitudinal series of pale to bright white spots between the dark bars form a series of distinct dark and bright white spots, the greatest contrast at base and on margin of dorsal fin. A similar series of contrasting bars along ventral midline and edge of anal fin. A row of evenly spaced, small, white (unpigmented) spots along length of midbody ("lateral-line" spots, the placement corresponding with lateral-line pores present in other anguilliform families) usually discernable. Head with small brown spots and white areas which are similar to body coloration dorsally, the brown spots fewer and appearing paler ventrally; distal edge of anterior nostril and rim of jaw pores unpigmented; prominent white patches on lower jaw surrounding posterior jaw pores, sometimes continuous around lower jaw; dark ring around eye. Great variability in head and body coloration; typical coloration described above, but specimens also appear pale overall with distinct or diffuse brown spots, medium brown with dark brown and white spots, or brown overall with a few scattered pale spots. Color variability is apparently not related to size, sex, or habitat; one collection (ROM 42851, from Fiji) with 12 specimens, 65–149 mm, included juveniles, males and females which randomly exhibited all phases of coloration. The alternating dark and white oblique bars on the posterior fins best serve to identify the species.

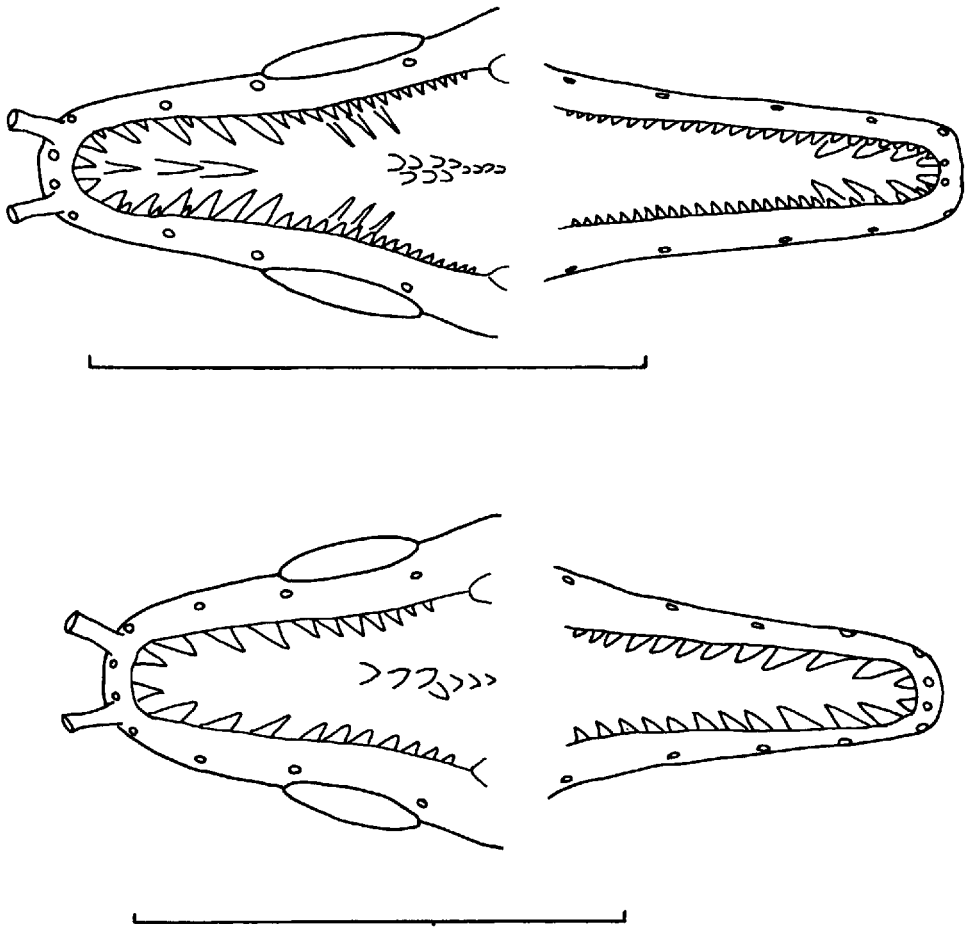

Figure 4. Diagram of dentition of *Gymnothorax robinsi*; left side upper jaw, right side lower jaw. A. ANSP 144432, 156 mm paratype, female dentition. B. ANSP 173507, 150 mm paratype, male dentition. Line = 10 mm.

This is a dwarf species, the largest specimen taken to date is 182 mm; females are ripe at 93–156 mm with 1.0–1.8-mm eggs; males are identifiable at 130 mm, ripe at 137–182 mm.

Distribution.—Found in the Indo-Pacific from Fiji to the Seychelles. Most specimens were taken by rotenone on shallow coral reefs; depths of capture ranged down to 35 m.

Remarks.—This species was discovered over 20 years ago when a few small specimens were x-rayed and the low vertebral count noted. As often happens with dwarf species, its description was postponed until "adult" specimens could be found; when none appeared, available specimens were examined and found to include mature males and females. Additional specimens were located, some mixed with or misidentified as other species with similar body coloration. *Gymnothorax zonipectis* Seale, 1906, has a similar body color of brown blotches (although it lacks pale spots posteriorly) and has alternating dark and pale oblique bars on the fins; however it possesses a distinctive streak behind the eye, a dark

area sharply delineated by contrasting white slashes above and below; *G. robinsi* lacks any dark marks on the head. The overall coloration is also somewhat similar to the blotched pattern of *Gymnothorax chilospilus* Bleeker, 1865; that species also has no dark head marks and the fins lack the oblique bars and have pale margins. Both of these species have a longer tail with the anus well before mid-body, the dorsal-fin origin well before the gill opening, and possess more vertebrae (MVF 6-48-126 for *G. zonipectis* and 5-49-124 for *G. chilospilus*).

When two patterns of dentition were first observed, the possibility of two look-alike species was considered; however, the differences were found to correlate with sex. A high degree of variation in dentition of morays has long been noted, and this has been suspected of contributing to the repetitive descriptions of some species. These variations have usually been attributed to ontogenetic change; small specimens frequently possess numerous and biserial jaw teeth, the teeth becoming fewer and uniserial with growth. In addition, the median intermaxillary teeth tend to disappear with age, and it has been noted that large males, in particular, often lack the characteristic fangs. Sexual condition has not been routinely determined and noted in studies of morays, and few attempts have been made to correlate dentition and sex. Recently, sexual dimorphism in the dentition in adults of three species of morays was described by Hatooka (1986): he found differences in the numbers of jaw teeth and median fangs in *Gymnothorax richardsoni* (Bleeker, 1852) (males 174–303 mm and females 149–313 mm) very similar to those recorded above for *G. robinsi.* In addition, he found differences in the shape of the teeth of *Echidna nebulosa* (Ahl, 1789) (males 432–626 mm, females 463–646 mm) and *E. polyzona* (Richardson, 1845) (males 363–648 mm, females 383–614 mm); he also noted the absence of median intermaxillary teeth in large males of the latter two species. Sexual dimorphism in the dentition of at least one other moray, *Rhinomuraena quaesita* Garman, 1889, is suggested by the description of *R. ambonensis* Barbour, 1908, the blue male form of the species, where variation in dentition (uniserial jaw teeth in *quaesita* vs. triserial in *ambonensis,* 28 vs. 15 lower jaw teeth respectively) was one of the two characters used to distinguish the two "species." A review of descriptions and comparison of sex with dentition of other described species might indicate additional cases of sexual dimorphism and aid in establishing synonymies of other species.

Etymology.—This distinctively marked and interesting moray is named for C. Richard Robins, "eelologist" and long-time colleague, advisor, and friend, who has contributed greatly to the knowledge and understanding of many fishes (including anguilliforms), with acknowledgment and thanks for his help and encouragement, both scientific and personal, over the past 37 years.

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